

12/04/02

From: Alan Raynes To: Examiner MacArthur

Date: 12/6/02 Time: 12:02:32 PM

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FACSIMILE COVER PAGE

To : Examiner MacArthur
Sent : 12/6/02 at 12:02:26 PM
Subject : allowed claims for 09/082,484

From : Alan Raynes
Pages : 15 (including Cover)

As requested, the claims are attached

Received from < alan > at 12/6/02 12:04:27 PM [Eastern Standard Time]

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ALLOWED CLAIMS

3. A system for processing a substrate, comprising:
- a first chamber;
 - a second chamber coupled to the first chamber and configured to perform a process on the substrate;
 - a valve to selectively seal the first chamber from the second chamber when closed and to permit transfer of the substrate between the first chamber and the second chamber through the valve when open;
 - a substrate transfer shuttle moveable along a linear path, defined by guide rollers, between one position in the first chamber and another position in the second chamber to transfer the substrate between the first chamber and the second chamber, and further moveable along the linear path between the another position in the second chamber and the one position in the first chamber to transfer the substrate between the second chamber and the first chamber, the shuttle having one or more substrate support fingers disposed thereon; and
 - a substrate support disposed in the second chamber and adapted to move from a lower position to a higher position, wherein at least a portion of the substrate support moves between the substrate support fingers of the shuttle.
13. An apparatus for processing a substrate, comprising:
- a load lock chamber for introduction of the substrate;
 - a processing chamber coupled to the load lock chamber and configured to perform a process on the substrate, said processing chamber having a susceptor for supporting the substrate during the process, the susceptor movable between lowered, intermediate, and raised positions, wherein the susceptor in the processing chamber includes a plurality of lift pins which are movable through holes in the susceptor and which support the substrate above the susceptor in the

Allowed Claims

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intermediate and raised positions;

a valve to selectively seal the load lock chamber from the processing chamber when closed and to permit transfer of the substrate between the load lock chamber and the processing chamber through the valve when open;

a substrate transfer shuttle moveable along a shuttle path between one position in the load lock chamber and another position in the processing chamber to transfer the substrate between the load lock chamber and the processing chamber, the substrate transfer shuttle configured and arranged so that when in said another position, the substrate may be removed from the substrate transfer shuttle by moving the susceptor from the lowered position to the intermediate position, after which the substrate transfer shuttle may be removed from the processing chamber, the shuttle having one or more substrate support fingers disposed thereon, wherein at least a portion of the susceptor is adapted to move between the substrate support fingers of the shuttle, wherein the substrate transfer shuttle includes:

first and second longitudinal side rails at respective first and second sides thereof;

a first plurality of the substrate support elements extending inwardly from the first longitudinal side rail and positioned to pass below the substrate when the substrate transfer shuttle is removed from the processing chamber; and

a second plurality of the substrate support elements extending inwardly from the second longitudinal side rail and positioned to pass below the substrate when the substrate transfer shuttle is removed from the processing chamber.

14. The apparatus of claim 13, wherein the lift pins are adjacent respective ones of the substrate support elements.

Allowed Claims

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15. The apparatus of claim 14, wherein said lift pins are nearer to a centerline of the substrate than the pluralities of substrate support elements.
16. The apparatus of claim 13, further including a plurality of pads located on said pluralities of substrate support elements to support the substrate above said substrate support elements.
17. The apparatus of claim 16, wherein said pads are sufficiently high such that bowing of a heated substrate does not result in the substrate directly contacting the substrate support elements.
18. The apparatus of claim 13, further comprising a plurality of stoppers located on said pluralities of substrate support elements to secure the substrate against lateral movement.
19. The apparatus of claim 13, further including a first cross member structurally connecting the first and second longitudinal side rails.
20. The apparatus of claim 19, further including a second cross-member structurally connecting the first and second longitudinal side rails and having an underside, the underside positioned to pass over the susceptor when the substrate transfer shuttle is introduced into or removed from the processing chamber.
21. The apparatus of claim 20, wherein at least the first longitudinal side rail has a portion extending beyond the second cross-member and accommodated within an associated alcove in the load lock chamber when the substrate transfer

Allowed Claims

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shuttle is in the one position.

22. The apparatus of claim 21, wherein the second longitudinal side rail has a portion extending beyond the second cross-member and accommodated within an associated alcove in the load lock chamber when the substrate transfer shuttle is in the one position.

23. The apparatus of claim 19, wherein the first cross-member has an underside positioned to pass over the susceptor when the substrate transfer shuttle is removed from the processing chamber.

24. The apparatus of claim 13, wherein said substrate support elements extend about 15-30% of a dimension of the substrate.

25. The apparatus of claim 24, wherein said substrate support elements extend about 22% of a dimension of the substrate.

26. The apparatus of claim 13, further including a first drive mechanism engageable with at least the first longitudinal side rail to move the substrate transfer shuttle along at least a first portion of the shuttle path.

27. The apparatus of claim 26, further including a second drive mechanism engageable with at least the first longitudinal side rail to move the substrate transfer shuttle along at least a second portion of the shuttle path.

28. The apparatus of claim 26, wherein the first longitudinal side rail includes a mechanical drive element.

Allowed Claims

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29. The apparatus of claim 28, wherein said mechanical drive element is a toothed rack.
30. The apparatus of claim 26, wherein the first drive mechanism is engageable with both the first and second longitudinal side rails.
31. The apparatus of claim 13, wherein the substrate support elements, extending inwardly from the first longitudinal side rail, each have a proximal portion extending at least in part upwardly from the first rail and have a distal portion extending inwardly from the proximal portion so that when the substrate transfer shuttle is supporting a substrate, an end effector may be accommodated vertically between the substrate and the first longitudinal side rail and laterally between at least some of the substrate support elements extending inwardly from the first longitudinal side rail.
32. The apparatus of claim 13, wherein the processing chamber includes a susceptor support depending from the susceptor, the susceptor support movable to raise and lower the susceptor and wherein at least a group of the first and second pluralities of substrate support elements are positioned to pass alongside the susceptor support when the substrate transfer shuttle is withdrawn along the shuttle path.
33. An apparatus for performing a process on a substrate, comprising:
a load lock chamber for introduction of the substrate;
a first processing chamber coupled to the load lock chamber and configured to perform a process on the substrate, the first processing chamber including a first susceptor to support the substrate during performance of the

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process and the first susceptor being movable between lowered, intermediate, and raised positions;

a valve to selective seal the load lock chamber from the first processing chamber when closed and to permit transfer of the substrate between the load lock chamber and the first processing chamber when open;

a substrate transfer shuttle supported on a track by rails extending from the shuttle and moveable along a linear shuttle path between one position in the load lock chamber and a second position in the first processing chamber to transfer the substrate between the load lock chamber and the first processing chamber, the substrate transfer shuttle configured and arranged so that when in said second position, the substrate may be removed from the substrate transfer shuttle by moving at least a portion of the susceptor from the lowered position to the intermediate position, after which the substrate transfer shuttle may be removed from the processing chamber;

a second processing chamber coupled to the first processing chamber and configured to perform a process on the substrate, the second processing chamber including a second susceptor to support the substrate during performance of the process and the second susceptor being movable between lowered, intermediate, and raised positions;

a second valve to selectively seal the second processing chamber from the first processing chamber when closed and to permit transfer of the substrate between the second processing chamber and the first processing chamber when open; and

wherein the substrate transfer shuttle is further moveable along a linear shuttle path between the second position and a third position in the second processing chamber to transfer a substrate between the first processing chamber and the second processing chamber, the substrate transfer shuttle configured and

arranged so that a substrate thereon in the third position may be removed by moving the susceptor of the second processing chamber from the lowered position to the intermediate position, after which the substrate transfer shuttle may be withdrawn from the second processing chamber.

34. An apparatus for performing a process on a substrate, comprising:
- a first chamber having a mechanism to support the substrate therein, the mechanism movable between retracted and extended positions;
 - a second chamber coupled to the first chamber;
 - a valve to selectively seal the first chamber from the second chamber when closed and to permit transfer of the substrate through the valve when open;
 - a substrate transfer shuttle supported on a track by rails extending from the shuttle and moveable along a linear path which extends at least between one position in the first chamber and another position in the second chamber to transfer the substrate between the first chamber and the second chamber, the substrate transfer shuttle configured and arranged so that a substrate in the one position may be removed from the substrate transfer shuttle by moving the support mechanism to the extended position after which the substrate transfer shuttle may be removed from the first chamber.

35. The apparatus of claim 34, wherein said second chamber further includes a mechanism to support the substrate therein, the mechanism movable between retracted and extended positions, so that a substrate in the another position may be removed from the substrate transfer shuttle by moving at least a portion of the support mechanism to the extended position after which the substrate transfer shuttle may be removed from the second chamber.

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36. An apparatus for performing a process on a substrate, comprising:

a first chamber having a mechanism to support the substrate therein, the mechanism movable between retracted and extended positions;

a second chamber coupled to the first chamber and having a mechanism to support the substrate therein, the mechanism movable between retracted and extended positions;

a first valve to selectively seal the first chamber from the second chamber when closed and to permit transfer of the substrate through the first valve when open;

a third chamber coupled to the second chamber and having a mechanism to support the substrate therein, the mechanism movable between retracted and extended positions;

a second valve to selectively seal the second chamber from the third chamber when closed and to permit transfer of the substrate through the second valve when open;

two substrate transfer shuttles, each moveable along a linear path which extends at least between one position in the first chamber and another position in the third chamber to transfer the substrate between the first chamber, the second chamber, and the third chamber, one of the substrate transfer shuttles to transfer substrates between the first chamber and the second chamber, the other of the substrate transfer shuttles to transfer substrates between the second chamber and the third chamber, said substrate transfer shuttles configured and arranged so that when in a selected one of the chambers, the substrate may be removed from the substrate transfer shuttle by moving the support mechanism to the extended position after which the substrate transfer shuttle may be removed from the selected one of the chambers; the shuttles each having one or more substrate support fingers disposed thereon, at least a portion of one or more of the

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mechanisms disposed in the chambers being adapted to move between the substrate support fingers of the shuttle.

37. An apparatus for performing a process on a substrate, comprising:
- a first load lock chamber;
 - a first load lock valve to selectively seal the first load lock chamber from the first chamber when closed and to permit transfer of the substrate through the first load lock valve when open;
 - a first chamber coupled to said first load lock chamber and having a mechanism to support the substrate therein, the mechanism movable between retracted and extended positions;
 - a second chamber coupled to the first chamber and having a mechanism to support the substrate therein, the mechanism movable between retracted and extended positions;
 - a first valve to selectively seal the first chamber from the second chamber when closed and to permit transfer of the substrate through the first valve when open;
 - a third chamber coupled to the second chamber and having a mechanism to support the substrate therein, the mechanism movable between retracted and extended positions;
 - a second valve to selectively seal the second chamber from the third chamber when closed and to permit transfer of the substrate through the second valve when open;
 - a second load lock chamber;
 - a second load lock valve to selectively seal the second load lock chamber from the third chamber when closed and to permit transfer of the substrate through the second load lock valve when open;

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two substrate transfer shuttles, each shuttle supported on a track by rails extending from the shuttle and moveable along a linear path which extends at least between one position in the first load lock chamber and another position in the second load lock chamber to transfer the substrate between the first load lock chamber, the first chamber, the second chamber, the third chamber, and the second load lock chamber, one of the substrate transfer shuttles to transfer substrates between the first load lock chamber, the first chamber and the second chamber, the other of the substrate transfer shuttles to transfer substrates between the second chamber, the third chamber and the second load lock chamber, said substrate transfer shuttles configured and arranged so that when in a selected one of the chambers, the substrate may be removed from the substrate transfer shuttle by moving the support mechanism from the retracted position to the extended position after which the substrate transfer shuttle may be removed from the selected one of the chambers.

38. An apparatus for processing a substrate, comprising:

- a first load lock chamber for introduction of the substrate;

- a second load lock chamber for removal of the substrate;

- at least one intermediate chamber located between the first and second load lock chambers, said intermediate chamber configured to perform a process on a substrate;

- a first valve to selectively seal the first load lock chamber from the intermediate chamber;

- a second valve to selectively seal the second load lock chamber from the intermediate chamber;

- a substrate transfer shuttle supported on a track by rails extending from the shuttle and moveable along a linear path defined by guide rollers between one

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position external to the intermediate chamber and another position in the intermediate chamber to transfer a substrate to the intermediate chamber, the substrate transfer shuttle configured and arranged so that a substrate in the intermediate chamber may be removed from the substrate transfer shuttle after which the substrate transfer shuttle may be removed from the intermediate chamber.

39. The apparatus of claim 38, further including a plurality of intermediate chambers located between the first load lock chamber and the second load lock chamber.

40. The apparatus of claim 39, further including two substrate transfer shuttles, a first one of said substrate transfer shuttles moveable along a first shuttle path between the first load lock chamber and the intermediate chamber and a second one of said substrate transfer shuttles moveable along a second shuttle path between the second load lock chamber and the intermediate chamber.

54. A system for processing a substrate, comprising:

a first chamber;

a second chamber coupled to the first chamber and configured to perform a process on a substrate;

a valve to selectively seal the first chamber from the second chamber when closed and to permit transfer of the substrate between the first chamber and the second chamber through the valve when open;

a support mechanism disposed in at least one of the chambers and movable between retracted and extended positions;

a substrate transfer shuttle supported on a track by rails extending from the shuttle and moveable along a linear path between one position in the first

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chamber and another position in the second chamber to transfer the substrate between the first chamber and the second chamber, the substrate transfer shuttle configured and arranged so that a substrate may be removed from the substrate transfer shuttle by moving at least a portion of the support mechanism to the extended position after which the substrate transfer shuttle may be removed from the respective chamber; and

a drive mechanism engageable with the substrate transfer shuttle to move the substrate transfer shuttle along at least a portion of the linear path.

61. A substrate transfer shuttle for carrying a substrate in a processing system having at least two chambers, the shuttle comprising:

- a) first and second longitudinal side rails;
- b) cross members proximate first and second ends of the first and second longitudinal side rails to structurally connect the first and second longitudinal side rails;
- c) a first plurality of substrate support elements extending inwardly from the first longitudinal side rail; and
- d) a second plurality of substrate support elements extending inwardly from the second longitudinal side rail;

wherein the shuttle has one or more substrate support fingers disposed thereon, the substrate transfer shuttle being moveable along a shuttle path between one position in a load lock chamber of the processing system and another position in a processing chamber of the processing system to transfer the substrate between the load lock chamber and the processing chamber, the substrate transfer shuttle configured and arranged so that when in said another position, the substrate may be removed from the substrate transfer shuttle by moving at least a portion of a susceptor from a lowered position to an intermediate

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position between the substrate support fingers of the shuttle, after which the substrate transfer shuttle may be removed from the processing chamber.

62. The apparatus of claim 61, wherein said substrate support elements extend about 15-30% of a dimension of the substrate.

63. The apparatus of claim 62, wherein said substrate support elements extend about 22% of a dimension of the substrate.

64. The apparatus of claim 61, wherein the first and second longitudinal side rails each include a toothed rack mounted on the underside thereof.

65. The apparatus of claim 61, wherein the substrate support elements, extending inwardly from the first and second longitudinal side rails, each have a proximal portion extending at least in part upwardly from the first longitudinal side rails and a distal portion extending horizontally inwardly from the proximal portion so that when the substrate transfer shuttle is supporting a substrate, an end effector may be accommodated vertically between the substrate and the first longitudinal side rail and laterally between at least some of the proximal portions of the substrate support elements.

66. The apparatus of claim 61, wherein at least the first longitudinal side rail has a portion extending beyond the second cross-member.

67. The apparatus of claim 61, wherein the distal portions of the substrate support elements are parallel.

Allowed Claims

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68. The apparatus of claim 61, wherein at least one of the distal portions of the substrate support elements is at an angle with respect to at least another of the distal portions of the substrate support elements.

Allowed Claims

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